DOCUMENT RESUME

EM 006 902

ED 025 155

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A Basic Reference Shelf on Interactive Use of Computers for Instruction. A Series One Paper from Eric at Stanford.

Stanford Univ., Calif. ERIC Clearinghouse on Educational Media and Technology.
Spons Agency- Office of Education (DHEW), Washington, D.C.
Pub Date Sep 68
Note- 21p.
EDRS Price MF-$0.25 HC-$1.15
Descriptors- *Computer Assisted Instruction, *Computer Oriented Programs, Computer Science, Conference Reports, Display Systems, Game Theory, Glossaries, Group Instruction, Individual Instruction, Information Retrieval, *Information Sources, *Interaction, Management, *Reference Materials, Research Reviews (Publications), Simulation, Symposia, Tutorial Programs
Identifiers- American Standards Association, Classroom Information Management Systems, Entelek Incorporated

The field of computer applications in education, characterized by continuous change in technology and nomenclature, is documented by diverse information sources. This paper names methods of organizing information on computer-based instructional systems and lists sources under literature surveys and reviews, conferences and symposia (1965-68, U.S.A.), publishers, and professional organizations. Interactive uses of computers for instruction include drill strategy, author-controlled tutorial, and "dialogue" tutorial; simulation and gaming; information handling, computation and display (scholarly aids); computer aids for instructional management; and computer-based tools for the author and researcher. The variety of lessons, systems, and languages for computer-based instruction depends on instructional objectives and on records of student performance. (TI)

A SERIES ONE PAPER FROM

ERIC at Stanford

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A BASIC REFERENCE SHELF ON INTERACTIVE USE OF COMPUTERS FOR INSTRUCTION

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The University of Michigan

September, 1968

EM006902

A BASIC REFERENCE SHELF ON

INTERACTIVE USE OF COMPUTERS FOR INSTRUCTION

I. INTRODUCTION

This paper provides a framework for information about a new technology of teaching and learning, and a list of information sources. Some space is taken to define the domain of interactive uses of computers for instruction, and to characterize the variety of current activities. However, the reader who wishes a more general introduction might consider the following articles:

"Computer Assistance for Instruction," in *Automated Education Letter*, Vol. I, No. 1, October 1965, pp. 4-15.

"Special Report on Technology for Education," in *International Science and Technology* (now *Science and Technology*), August 1967, pp. 29-97.

"Information" (an entire issue), *Scientific American*, Vol. 215, No. 3, September 1966. Reprinted by W. H. Freeman & Co.

The field of computer applications in education is now characterized by rapid technological development and a continuous change in the state-of-the-art. Therefore it is not sufficient to list current books and articles, and I shall try to include in Section VII some likely sources of future publications.

II. DEFINITION

Many names have been associated with some part of the general area dealing with interactive uses of computers for education. Computer-assisted or computer-aided instruction (CAI), adopted by IBM in their early writing

about instructional systems, is probably the most commonly used at this time, while System Development Corporation and later Stanford University and RCA have used the term computer-based instruction (CBI). Computer-assisted learning and computer-augmented learning have been suggested as being more descriptive of the variety of uses intended to aid the student in the learning process; however the resulting acronym (CAL) introduces further problems due to its use in association with a large state university, a conversational algorithmic language for interactive computing developed at the Berkeley campus of that university, and a course author language for automated instruction under development at the Irvine campus of the same university.

Other terms have been used to imply a broader range of concern, e.g., computer assisted education or computer augmented instructional systems. Some of the projects, with a particular focus on computer use by the teacher handling performance records and curriculum files, have used the label "computer-managed instruction" (CMI). This descriptor implies that the student does not receive instruction directly from the computer; various non-computer media are "managed" or scheduled for him by his teacher with the assistance of automatic data processing.

The Educom Task Force on Educational Systems and Technology on occasion has discussed this nomenclature problem but has not produced any satisfactory recommendation for the field. Acronyms tend to become associated with one manufacturer, computer system, or research and development project; it is just as well if they are not used to describe the entire field. I hope to refer to information about a variety of applications including computer assistance in the preparation of materials, the management of instruction, the execution of research, individual study or research by the student, and author-directed instruction of the kind usually called CAI.

There are many glossaries of terms covering computing and information processing, and some of them can be obtained from computer company representatives. A list of definitions and references is available from the American Standards Association, 10 East 40th Street, New York, N.Y. 10016.

A glossary of terms in the area of computing *(Automatic Data Processing Glossary)* was prepared by the Bureau of the Budget in 1962 and is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. for 40¢. It was reprinted in the *Automated Education Handbook* in 1965, but a glossary exclusively concerned with interactive use of computers needs to be written.

Frequently I hear educators ask "What is the relation of CAI to PI?" Opinion about programmed instruction also suffers from problems which result from casual naming and inadequate definition. If PI is considered a medium, that is, a format for printed instructional materials, then it is distinct from CAI as a medium for presenting materials with an electric typewriter or electronic display screen (cathode ray tube) connected to a computer. However, much of the material now available for use with computers looks very much like computerized versions of programmed texts, slides or audio tape. Only some of the computer-based exercises emphasize dynamic interaction, computation, or other information-processing functions that are not readily provided by the lesson author in paper-and-pencil format.

If programmed instruction is interpreted not as a medium but as a strategy for development and validation of instructional materials, it is a strategy which may be applied to development of materials in various media such as textbooks, workbooks, laboratories, films, computer-controlled audio-visual materials, simulated environments, and even general-purpose, problem-solving environments. In Section III I shall enumerate various conversational uses of computers, some of which depend on strategies derived from programmed instruction and others which look like straightforward use of the computer as a tool for computation, information-processing or graphic-manipulation.

III. MODES OR USES

Drill, author-controlled tutorial and "dialogue" tutorial. For this kind of computer assistance with student learning it is typical for the author to define objectives and describe the subject matter in considerable detail. Computerized drill strategies have been used heavily in an experiment with initial reading and math curriculum in some of the Palo Alto, California, schools[1, 2] and in language laboratory exercises at the State University of New York at Stony Brook.[3] Much of the work done at Penn State and Florida State can be characterized as individualized versions of lecture, text or examination material. This has been called automated tutorial, but the conversation remains very much under the control of the author of the computer program. Computer-based exercises which I characterize as "dialogue" tutorial appear to me to encourage additional initiative on the part of the student and to provide suitable rewards. That is, the student may ask questions, direct the discussion to some extent, and construct solutions to problems set for him by the author. Two typical examples of the method concern practice in medical diagnosis[4] and discussion of problem solutions in college physics.[5]

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[1] Atkinson, Richard C. and Duncan N. Hansen, "Computer-assisted Instruction in Initial Reading: The Stanford Project," *Reading Research Quarterly*, Vol. 2, 1966, pp. 5-25.

[2] Suppes, Patrick, "The Uses of Computers in Education," *Scientific American*, Vol. 215, No. 3, September 1966, pp. 207-220.

[3] Adams, E. N., H. W. Morrison and J. M. Reddy, *Conversation with a Computer as a Technique of Language Instruction*. RC 1815. IBM Research, Yorktown Heights, New York, May 1967.

[4] Swets, John A. and Wallace Feurzeig, "Computer-aided Instruction," *Science*, Vol. 150, October 29, 1965, pp. 572-576.

[5] Taylor, E. F., "The Eliza Program: Conversational Tutorial," *IEEE International Convention Record Part 10*. New York: Institute of Electrical and Electronic Engineers, 1967, pp. 8-15. Also available with other papers on ELIZA from Educational Research Center, MIT, Cambridge, Massachusetts.

Simulation and gaming. These kinds of applications differ from the previous group in that the conversation between student and program and the results he obtains follow from a general model rather than a frame-by-frame specification. In other words, the designer of the learning exercise may not have anticipated in detail each course of action or outcome. This generality becomes possible if the computer program underlying a game or simulation describes a model designed to provide some appropriate reply no matter what the student should type. Such models can also be used in research to provide artificial situations for initial testing of new hypotheses under favorable conditions of control and observation.

Simulations attempt to model some aspects of the real world for study or research. Computer-based games usually place the student in less realistic situations, provide specific payoffs, and introduce competition with other students. Typical applications of both modes are found in elementary school social studies,[6] high school career planning[7] and college chemistry (at the University of Texas).

Scholarly aids: information handling, computation and display. Computer tools for the organization and retrieval of information should be as useful to the student as they are to any scholar working with a broad base of information. A number of experimental systems designed to provide such assistance show considerable promise but are still rather expensive; I know of no extensive experiments conducted in typical learning situations.

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[6] Leonard, Jimmer M. and Richard L. Wing, "Advantages of Using a Computer in Some Kinds of Educational Games," *IEEE Transactions on Human Factors in Electronics*, Vol. HFE8, No. 2, June 1967, pp. 75-81.

[7] Ellis, Allan B. and Charles S. Wetherell, "The Computer and Career Decisions," *Technical Memorandum 1*, Grant No. 1-061819-2240. Harvard University, Cambridge, Massachusetts, September, 1966.

Computation is such an obvious application that it tends to be overlooked by the planner of a computer-based instructional system. Notable experiments are being conducted in the Massachusetts public schools,[8] the University of California at Santa Barbara,[9] and System Development Corporation.[10]

Interactive use of computers has potential for problem solving in all areas, including the arts and humanities. Computers are being used increasingly by artists and scholars in connection with musical compositions, creative writing, experimental films and architectural designs. I believe it is especially important that students from these areas outside science and engineering be given access to computing capability through well designed study carrels and readily comprehended programming languages.

Computer aids for instructional management. Public schools probably will be able to provide interactive computer assistance to a few "managers" of instruction sooner than they can to each individual student. Knowledge gained through semi-automated handling of instructional materials and performance records will contribute to effective implementation of other interactive uses of computers by students directly. The Oakleaf school project[11] began with much teacher-student contact and a large clerical

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[8] Feurzeig, Wallace, "New Instructional Potentials of Information Technology," *IEEE Transactions on Human Factors in Electronics*, Vol. HFE8, June, 1967, pp. 84-88.

[9] Fried, B. E., "Solving Mathematical Problems," *On-Line Computing*, Walter J. Karplus (Editor). New York: McGraw-Hill, 1967, pp. 131-176.

[10] Rosenbaum, J., Samuel L. Feingold, Charles H. Frye and F. D. Bennik, "Final Report," *Computer-Based Instruction in Statistical Inference*, System Development Corporation, Santa Monica, California, October, 1967.

[11] Lindvall, C. M. and John O. Bolvin, "Programed Instruction in the Schools: Individually Prescribed Instruction," *Sixty-sixth Yearbook of the National Society for the Study of Education, Part II: Programed Instruction*. The National Society for the Study of Education, 1967, pp. 217-254.

staff. Gradually the clerical burden is being replaced by computer programs, and the routine contact with students will be taken over by student interaction with computer programs.

A symposium on Classroom Information Management Systems was held at the 1968 Annual Meeting of the American Educational Research Association. Details of current projects can be obtained from those who made presentations: Harry Silberman and Beverly Kooi of System Development Corporation, Santa Monica, California; James Becker of Research for Better Schools Corporation, Philadelphia; and John Flanagan of AIR in Palo Alto, California.

Computer-based tools for the author and researcher. Convenient languages are needed for specifying interactive instruction in ways which can be processed by computer programs. A working group established by Educom (Interuniversity Communications Council, see Section VII) is assembling a set of documents which are intended to describe various programming languages and to recommend additional requirements which are not presently met. Some of the systems described in a preliminary report provide capability for interactive composition and revision of materials; the author can change his text, diagrams or learning strategy by typing instructions on a keyboard or by moving a pointer about on a television screen to indicate new arrangements of text or diagrams. Suitable computer programs can also assist with the preparation of a first draft of a teaching sequence.

A first approximation of a computer-based learning exercise might be derived from a specially-written text, a set of test papers which have been graded, or a description of objectives for student performance at the end of the exercise. A few projects have demonstrated that computer programs can generate additional materials as needed for each individual student. That is, an additional teaching example or test situation can be assembled from elements and rules provided in advance by the author to describe the subject matter. Finally, computer programs should help with data analysis and decisions in research and modification of instructional packages.

IV. VARIETY OF LESSONS, SYSTEMS AND LANGUAGES

Materials are being written in almost all subject areas and for many age levels. Abstracts of computer programs for instruction are collected by Entelek Incorporated (see Section VII below). The appropriateness and effectiveness of computer assistance in each field depends on characteristics of each instructional objective. Subject experts will determine where and how the computer is used, but the evaluation should be based on records of student performance.

Presumably computers will provide some advantage through increased learning and perhaps reduced cost. I have suggested criteria for using computers which include: 1) processing and evaluation of responses typed or spoken by the student, 2) complex sequencing or selection rules, or self-modifying strategies of instruction, and 3) generation or assembly of new material. There are also some obvious limitations: it is difficult for a computer to process and evaluate the content of essays,[12] complex physical constructions and facial expressions. Lack of organization of a subject may make computer presentation difficult where live individual instruction can be reasonably successful.

A number of different kinds of computer systems are being used by current research and development projects. Some small computers have been programmed for use by one student at a time for self-testing, computation, simulation, and even design of games[13] for another student to play, or for vocal skills practice.[14] Somewhat larger systems, similarly dedicated to

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[12] The reader may want to check some interesting work on evaluation of mechanics and style reported by Ellis Page, "Grading Essays by Computer: Progress Report" in *Invitational Conference on Testing Problems*, October 1966, Princeton: Educational Testing Service, 1967, pp. 87-100.

[13] Starkweather, John A., "COMPUTEST: A Computer Language for Individual Testing, Instruction, and Interviewing," *Psychological Reports*, Vol. 17, 1965, p. 237.

[14] Lane, Harlan L., "Conditioning Accurate Prosody," *Audiovisual Instruction*, Vol. 11, October 1966, pp. 621-23.

a single purpose, have been programmed for simultaneous use by 4 to 32 students; these can be characterized as multiple-user teaching machines. (Information can be obtained from IBM, RCA, Philco-Ford, Technomics and perhaps other manufacturers.) Larger systems have been proposed which would handle up to 200 students simultaneously using the same or similar teaching programs. Other research and development projects have used general-purpose conversational systems, imbedding the conversational instructional applications among other applications available to users. In the latter instance the student may use the same computer for tutorial, self-testing, simulation, gaming, and problem solving. Examples of uses of campus time-sharing systems for instruction in other than computer science are common now, although technical reports describing their applications are not usually published.

The current trend in computer use appears to be away from a sequence delivered by the computer under strict control of the author's program. It appears more likely that managers of future systems will make the primary sources of knowledge more available to students through organized files of information and procedures. Students will be given the necessary learning tools for information management, computation and composition; learning exercises will be characterized by practice in information acquisition and decision making, and students will take more control over their learning environments.

I still believe that for certain students and instructional objectives the effectiveness of computerized author-controlled tutorial presentations will be sufficiently greater than non-computer presentation of similar materials to justify the greater cost per unit. For example: children may lack the verbal skills, discriminations and attention span needed for independent study without the aid of the computer; other students (both grade school and college level) studying written and spoken language may benefit from computer assistance for diagnostic self-testing.

Expensive on-line systems will continue to be used for research and materials development, often in the natural environment. From training

devices located in public school classrooms, business offices, and engineering shops or laboratories, a central computer and communications system can instruct, record data, and test hypotheses regarding instruction and learning with great detail and over long periods of time. I believe that this capability to mix experimental control with real situations will help bridge the gap between contrived laboratory situations and actual application of learning principles in the classroom.

The cost in preparation and use of computer-based exercises will continue to be high[15] and not readily distributed over large numbers of students. However, I anticipate that communication networks will stimulate and technically assist groups of subject experts working cooperatively on computer-based materials for similar courses taught at different institutions. It is likely that materials developed on a cooperative basis will be more relevant and applicable to many different institutions than materials developed through independent ventures. Guidelines for organization and documentation of computer-based exercises are now being written which will make revision and use easier and more effective at new locations. Computer aids for searching and editing local copy could help a second user to explore and modify the materials for better use by his students.

Computer-based networks will distribute interactive information-processing services which individual institutions and community education programs could not afford separately.[16] Ultimately, the resources of entire regions will be made available to enrich and individualize the program of each student, no matter what his geographical location.

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[15] Kopstein, Felix F., and Robert J. Seidel. "Computer Administered Instruction versus Traditionally Administered Instruction: Economics," *Audio-Visual Communication Review*, Vol. 16, No. 2, Summer, 1968, pp. 147-78.

[16] Brown, G. W., S. G. Miller, and T. A. Keenan. *EDUNET:* Report of the Summer Study on Information Networks Conducted by the Interuniversity Communications Council (EDUCOM). New York: John Wiley & Sons, Inc. (1967).

V. LITERATURE SURVEYS AND REVIEWS

There are many ways to organize information about computer-based instruction systems: student levels, subject areas, learning strategies, hardware systems, programming languages, computer functions and user purposes. Nearly all of these arrangements are represented in the following sample of surveys and reviews arranged alphabetically by author.

An Article by Bushnell in *Audiovisual Communications Review*, 1963, gives an overview of various uses of computers in education, although the description of operating systems is no longer current.

A bibliography and KWIK index was published by Engel in January of 1967 and revised in August (Programming Systems Branch, USNWL, Dahlgreen, Va. 22448). It overlaps the Entelek bibliography, but does include some annotations in its published version. The Entelek abstract card file (see Section VII) is more extensive and includes longer annotations, but the report abstracts are available only by annual subscription or participation in the exchange.

Gentile circulated a review in 1966 which appeared in the *Audiovisual Communications Review*, Spring, 1967. After a brief history he proceeded to discuss the semantic problem of programmed content and strategy, author language convenience, system capability and the effectiveness problem for instructional materials.

A chapter by Hansen in the *Review of Educational Research*, December, 1966, describes psychological experimentation and simulation as well as different applications of computer-assisted instruction. It gives particular attention to research studies (which have been few).

Hickey and Newton published a survey of the literature in 1966 and again in 1967, drawn from the files of the Entelek indexing and abstracting service (see Section VII). The January 1967 version is rather comprehensive and gives appropriate attention to research reports and documentation of instructional materials which have been prepared. The only serious errors

are in classification of systems and languages. A 1968 edition is expected to be available in July.

A book by Uttal (*Real-Time Computers: Technique and Applications in the Psychological Sciences*, Harper and Row, 1967) includes a chapter titled: "Computer Teaching Machines." In his discussion of psychological foundations and of types of computer teaching machines, Uttal emphasizes the unique contributions automated information processing systems can make through technology for generation of the steps in a sequence of instruction.

In a review circulated in 1966 and published in *The Computer in American Education* (John Wiley, 1967) I described computer contributions to communication. One section lists information arranged by project or computer system, and may be useful when planning visits or phone calls to obtain detailed information about system design, research, applications, and instructional materials under development.

In a chapter in the *Review of Educational Research*, December, 1967, I covered modes of computer assistance for the student, strategies for computer-based learning situations, computer aids for instructional management, computer-based tools for the author and researcher, computer-aided design of learning situations, and trends and projected needs.

VI. SINGLE MEETINGS, CONFERENCES AND SYMPOSIA (1965-1968, U.S.A.)

The following materials, organized chronologically by date of occurrence, may provide further references for the reader by providing publications and proceedings which were an outcome of the meetings held, and also assist the reader by suggesting where to look for materials resulting from meetings or conferences to be held in the next year or so.

A conference was sponsored by AEDS and Stanford University on uses of computers in American education in October of 1965. Sections of two of the presentations appeared in the *Saturday Review of Literature*, 1966,

and the conference report was published by John Wiley, June 1967 (*The Computer in American Education*, edited by Don D. Bushnell and Dwight W. Allen).

A conference on the Computer in American Universities was held at the University of California at Irvine, California, in November of 1965. The contributed papers were published in August 1967 with an edited transcript of discussion (*Computers and Education*, edited by Ralph Gerard, McGraw-Hill).

The Commission on College Physics also sponsored a conference in November at Irvine. The report of that working session, *The Computer in Physics Instruction*, is available from the commission at the University of Maryland. It is of somewhat lesser scope than the other Irvine conference, but it includes more detail and a number of examples of interest to non-physicists as well as physicists. A revision is under consideration.

In March 1966 the ONR[17] CAI interest group met in Cambridge at Bolt Beranek and Newman and at Harvard University Computation Center. Participants discussed CAI languages for both students and authors. A summary was distributed by Entelek and appeared in *Automated Education Letter*. In July of 1966, Educom established an informal working group in the area of author languages.

During July, 1966, Educom assembled a number of experts and representatives of member institutions to discuss and plan a network for communication among colleges and universities in North America. The report of that conference detailed designs and projections of need and probable uses for network services. The report was published in July 1967 (*Edunet: Report of the Summer Study on Information Networks*. George W. Brown, James G. Miller and Thomas A. Keenan. John Wiley).

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[17] The Office of Naval Research (ONR) has supported many of the innovative projects in this area, and through Entelek has encouraged meetings to exchange information.

In August of 1966 and 1967, educational technology and special equipment were described and demonstrated at a conference of the American Management Association (135 W. 50th, New York, N. Y. 10020). The programs describe topics and participants; no summary of the sessions is available. The 1968 session was scheduled for August 13-15.

The ONR CAI interest group met at System Development Corporation, Santa Monica, California, in September, 1966. On the first day, various SDC programs exploring computer aids in educational systems were described. On the second day, participants discussed issues related to successful implementation of CAI. A summary of these sessions is also available from Entelek; sections of the summary appeared in *Automated Education Letter*, January and February, 1967.

The ONR CAI interest group met at Penn State University in April 1967. Research and development activity in technical education using an IBM 1410 and experimental Coursewriter was described. A summary was distributed by Entelek.

The Education Policy Project at George Washington University conducted a "traveling seminar" for the Office of Education during July of 1967. The background papers, briefing sessions and conclusions of the seminar participants are presented in the final report titled *Education in the 70's*. Copies are available through ERIC.

The meetings of Project ARISTOTLE (Annual Review and Information Symposium on the technology of Training, Learning and Education), in December of 1967, included a session on use of computers in education under Task Group #5 on New Developments in Computers and Communications. Copies of the proceedings are available from the National Security Industrial Association, Suite 800, 1030 15th St., N. W., Washington, D. C. 20005.

An ONR interest group on simulation in instruction met at The University of Texas in Austin, January 1968. Special attention was given to projects of the CAI lab at Texas, and the simulations for testing and training at

the manned space flight center in Houston. Notes have been distributed by Entelek, and a longer report is in preparation by C. Victor Bunderson, Director of the CAI Lab at Texas.

An ONR interest group on CAI in medical education met in Cambridge in February 1968. Work in progress at a dozen locations throughout the country was demonstrated by remote teletype and video tape. Proceedings are in preparation by Lawrence N. Stolurow, Director of the Harvard CAI Laboratory, and will be available through Entelek.

A conference on the use of computers in Medical Education was held at the University of Oklahoma Medical Center in April 1968. Sessions considered computers in undergraduate, clinical, and continuing education, as well as their use in medical libraries. The conference proceedings were to be available from Dr. William G. Harless, Computer Facility, University of Oklahoma Medical Center, 800 N.E. 13th Street, Oklahoma City, Okla. 73104.

VII. PUBLISHERS AND PROFESSIONAL ORGANIZATIONS

Publishers and professional organizations who periodically publish materials relevant to interactive uses of computers in education are listed here. I have not included the regular index and review publications in education.

American Educational Research Association (AERA), 1201 16th St., N.W., Washington, D. C. 20036. Richard A. Dershimer, Executive Officer.

The *Educational Researcher* is the official newsletter of the association and is published about seven times a year. It mentions meetings, new federal programs, and the initiation of major research projects. $2.50 per year.

The *American Educational Research Journal* has an article related to computers in education nearly every issue (quarterly). $6 per

year. The annual meeting in February is likely to include reports of current research and development.

American Federation of Information Processing Societies (AFIPS), 211 E. 43rd St., New York, N. Y. 10017.

The Fall Joint Computer Conference (FJCC) and Spring Joint Computer Conference (SJCC) include sessions relevant to instruction, sometimes under the headings system design, programming languages, and natural language processing, as well as computer-assisted instruction.

The Conference Proceedings of FJCC and SJCC are published by Spartan Books, Thompson or some other independent publisher at the times of the meetings (November and April).

Association for Computing Machinery (ACM), 211 E. 43rd St., New York, N. Y. 10017.

A number of the monthly issues of *Communications of the ACM* include articles on use of computers for instruction. Often these are concerned with the training of computer programmers, technicians and users. Sections on programming languages and computational linguistics occasionally are relevant to instructional programs. $20 per year.

The *Journal* occasionally includes relevant material, and issues of *Computing Reviews* very frequently have abstracts of technical reports and papers from projects using computers for instruction.

Annual meetings in August include papers on instructional use of computers.

The Association has established a Special Interest Committee on Computer Assisted Instruction (SICCAI) which distributes a newsletter (INTERFACE, Donald Reynolds, Editor. TCU Instructional Systems, Fort Worth, Texas 76129) and plans sessions for ACM and AFIPS meetings.

Association for Educational Data Systems (AEDS), 1201 16th St., N.W. Washington, D. C. 20036.

AEDS Monitor, the magazine of the Association, is published 11 times each year. Most material has been on data processing. $15 per year.

The Journal of the Association of Educational Data Systems began in the summer of 1967 and will be published four times each year. It is likely to include many articles on computers and education. $10 per year.

The annual meeting of the Association in March or April always includes sessions on computers and instruction.

A series of workshops on educational data processing held at various locations during 1967-68 included sessions on CAI. Proceedings will be available from AEDS.

Automated Education Center, P.O. Box 2658, Detroit, Michigan 48213. Frank H. Gille, Publisher.

The Automated Education Handbook ($35) and two monthly newsletters (*Automated Education* and *Data Processing for Education*, each $18 per year) provide information about programmed instruction, audio and visual media and computer assistance. Most of the material in the letters is written for potential users of computers to be found among teachers and administrators. The Handbook includes research reports, discussion of procedures, and summaries of technology and applications.

Berkeley Enterprises, 815 Washington St., Newtonville, Massachusetts 02160. Edmund C. Berkeley, Editor and Publisher.

Computers and Automation is a monthly journal; articles are usually informal and descriptive. Sometimes information about a new project appears here before it is reported more formally. $15 per year.

Datamation, 1830 W. Olympic Blvd., Los Angeles, California 90006. Robert B. Forest, Editor.

This monthly trade journal includes occasional articles on the use of computers in instruction. A special issue on computers and education was prepared for fall of 1968. $15 per year; complimentary subscriptions available.

Educational Systems Corporation, Box 3711, Georgetown Station, Washington, D.C. 20007.

Journal of Educational Data Systems (quarterly) includes articles on uses of computers for instruction, especially for the teaching of programmers and technicians. The Fall 1967 issue is devoted to CAI. $9 per year.

Educational News Service, Box 508, Saddle Brook, New Jersey 07662. Lawrence Lipsitz, Editor.

Every issue of *Educational Technology* (semi-monthly, 24 per year) has one or more news articles or notes on instructional use of computers. $10 per year. May soon go to $12 and 12 issues per year.

Educom (Interuniversity Communications Council), 100 Charles River Plaza, Boston, Mass. 02114. Jordan Baruch, President.

The central office distributes a bulletin to the faculty of over 80 member institutions. $10 per year.

Needs in the area of computer uses for instruction are reviewed along with other topics by panels concerned with technology and applications. A set of documents on programming languages and technical assistance for authors is in preparation under the direction of a panel, and in cooperation with the Center for Research on Learning and Teaching, The University of Michigan.

A pilot network has been proposed which would assemble directory and information services, recommend standard practices, and facilitate cost sharing of communication circuits and special computer facilities for remote use or for information exchange.

Entelek, Inc., 42 Pleasant Street, Newburyport, Massachusetts 09150. Albert Hickey, President.

Under contract to the Office of Naval Research (ONR), Entelek conducts a CAI Information Exchange which periodically distributes abstracts of CAI research documents, summaries of operational CAI programs, and descriptions of individual CAI facilities. Data cards (5"x 8") are mailed in multiple copies for cross-indexing and are accompanied by author, subject, KWIC, and bibliographic indexes. ONR has paid the costs for about 60 institutions active in the CAI field and in the exchange; others may subscribe at $98 per year.

The CAI program abstract cards have been prepared for publication in the *CAI Guide*, June 1968. $10.

Entelek assists with CAI interest group meetings, publishes summaries, and distributes a monthly newsletter, entitled "News About CAI."

The first two editions of *CAI: A Survey of the Literature*, based on data in the information exchange, were published in 1966 and 1967. The 1968 edition is expected in July. $3.

ERIC Clearinghouse on Educational Media and Technology, Stanford University, Stanford, California 94305.

Current literature is abstracted and reported in *Research in Education* ($11 per year, U.S. Government Printing Office, Washington, D. C. 20402). Documents are available from ERIC Document Reproduction Service in microfiche or photocopy.

The clearinghouse will also distribute occasional state-of-the-art papers and annotated bibliographies directly from Stanford, and its newsletter is free to those requesting it.

Institute of Electrical and Electronic Engineers (IEEE), 345 E. 47th St., New York, N.Y. 10017.

Proceedings of the IEEE occasionally is devoted entirely to computers and related subjects. The last such issue was December 1966; it contained some papers on computer-aided instruction. The November 1967 issue was devoted to computer-aided design. $22 per year; single copy of special issues $4.

IEEE Transactions on Human Factors in Electronics (name being changed to *Transactions on Man-Machine Systems*), *IEEE Transactions on Education* and *IEEE Transactions on Electronic Computers* often include relevent papers. A special issue of the first journal, June 1967, focused on computers and education. Subscription prices vary; single copy $5.

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